REVIEW ARTICLE

Dentascan: A Diagnostic Boon

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ABSTRACT

In the past diseases in the maxillofacial region were evaluated by plain radiography or tomography. The advent of spiral computed tomography and Dentascan is changing the imaging trends. Unlike the previous imaging technique, the oblique saggital view permits the evaluation of distinctly buccal and lingual cortical bone margins, as well as clear visualization of the internal structure such as incisive and inferior alveolar canals. The aim of this review article is to explore the diagnostic role & clinical usefulness of Dentascan in maxillofacial region.

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1. INTRODUCTION

Dentascan is a computed tomography (CT) software program that allows the mandible and maxilla to be imaged in three planes: axial, panoramic and cross-sectional. It has been widely used pre-operatively for implant surgery as it provides a comprehensive assessment of the bone morphology and measurement of the dental implant. Introduced in the mid-1980s, Dentascan offered improvements in the evaluation of the osseous mandible and maxilla and has been reported to be useful in head and neck surgery[1,2,3]. It is an interactive CT imaging software that combines the power and detail of CT imaging with the convenience of interacting with the images on a desktop or notebook computer. To a limited degree in some clinical settings, the clinician can work with the radiology technician to interact with CT imaging. The commercially available desktop interactive software permits the clinician to view the radiographic studies in two or three dimensions, make direct measurements, assess bone volumes and density, manipulate the images to simulate implant placement or bone grafting procedures, and simultaneously view the images in all the three planes.[4]

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2. USES

2.1 As an adjunct for treatment planning before implant placement:

Clinical success of dental implants is influenced by both the volume (quantity) and density (quality) of available bone (Table 1). Bone quality and quantity varies from site to site and from patient to patient. Results of studies indicate higher survival rates for implants placed in bone of good quality and quantity, such as that in the anterior region of mandible. Therefore an accurate evaluation of bone structure is essential prior to implant placement[5] (Table1). In 1989 Misch proposed classification of bone density based on macroscopic finding and suggested implant design, surgical protocol, healing treatment plans, and progressive loading time spans for each bone density type[6] (Table 2). Dental CT software programs can identify the optimal site of implantation by locating exact position of inferior alveolar canal (Fig1a&Fig1b) and maxillary sinus(Fig2a &Fig2b) and demonstrating the contour of the jaw and area of maximal bone height, width and density. After determining the appropriate cross-sectional images, one can measure the

TABLE 1 : Usual anatomic location of bone density types (% occurrence)

Bone	Anterior Maxilla	Posterior Maxilla	Posterior Mandible	Posterior Mandible
D1	0	0	6	3
D2	25	10	66	55
D3	65	50	25	46
D4	10	40	3	1

TABLE 2 : Misch Bone Density Classification

Bone	Density
D1	Dense cortical bone
D2	Thick dense to porous cortical bone on crest and coarse trabecular bone with in
D3	Thin porous cortical bone on crest and fine trabecular bone with in
D4	Fine trabecular bone
D5	Immature, non mineralized bone

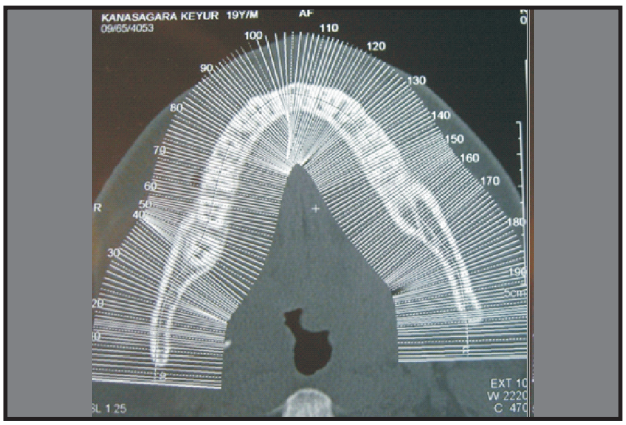

Fig 1a: Panoramic section in the dentascan

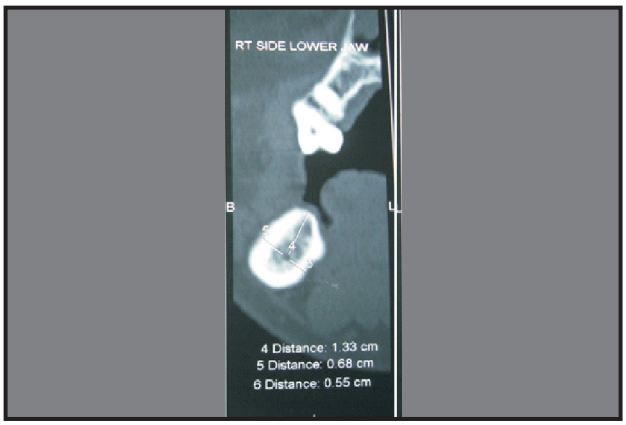

Fig 1b : Corresponding coronal sections used for measurement of the width of bone mesio distally as well as bucco lingually in mandible

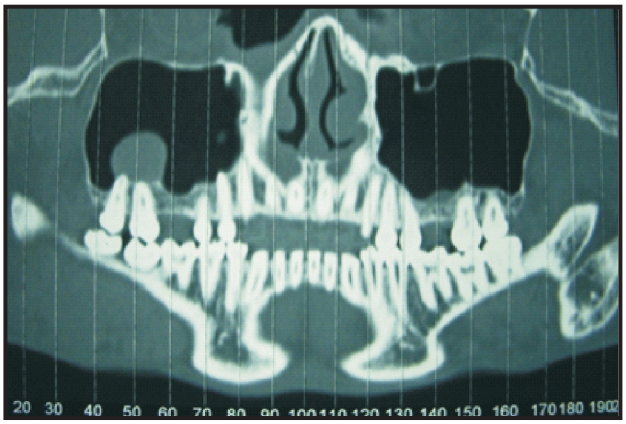

Fig 2a : Panoramic section in the dentascan

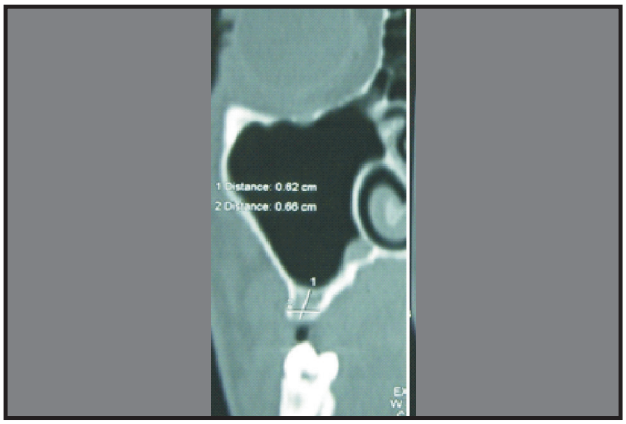

Fig 2b : corresponding coronal sections used for measurement of the width of bone mesio distally as well as bucco palataly in maxilla

height and width of alveolar ridge and asses the bony contour and density in the desired region[7].

2.2 In pathologies related to oral cavity:

Dentascan offers not only excellent comprehensive assessment of bone morphology for implants but also aids in diagnosis of other pathologies related to oral cavity.Most masses within the oral cavity, both benign and malignant, are amenable to direct clinical examination. The primary purpose of imaging is to detect deep or submucosal extent and adjacent osseous involvement. Bony erosion is better characterized by multi-planar CT Unlike standard pantomography, there is no super-imposition of other osseous structures in Dentascan. The image quality is sharp and clear, providing better tissue contrast resolution. Anatomic structures such as the inferior alveolar canal, mental foramen, mandibular foramen, buccal and lingual cortical margins, and the wall of the maxillary sinus can be clearly identified and evaluated. It is essential to evaluate the mandible in Dentascan these cases as it affects patient management.. On cross-sectional views in Dentascan, buccal and lingual cortical involvement is clearly identified. These views provide the surgeon with better pre-operative information in relation to the extent of resection and patient counselling[8,9] (Fig3).

Similarly in cases diagnosed with odontogenic tumours such as ameloblastoma, the distal ascending ramus

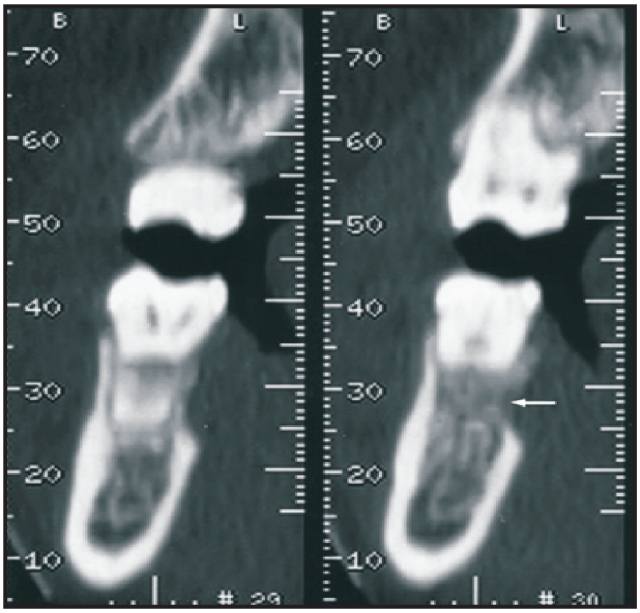

Fig 3 : Oral scc with mandibular erosion cross sectional view shows subtle focal cortical thinning

and molar regions are most commonly affected. Although pantomography was often used for assessment of this tumour in the past, Dentascan now provides a better evaluation of the lesion[10] (Fig4). Other benign tumours such as cementoblastoma,which is characterized by the formation of a cementum or cementum-like mass connected with a tooth root. On plain radiography and pantomogram, the lesion is well defined, with central radiopaque material, is attached to the tooth root and a surrounding radiolucent zone of uniform width, which represents the peripheral unmineralized tissue. The author could find no previous report of the appearance of a cementoblastoma on a Dentascan. The Dentascan findings were similar to those on plain radiography (Fig5a&Fig 5b).

Further in osteogenic sarcoma of the mandible, the radiographic[11] and CT findings are variable and non-specific. Some indicate an aggressive neoplastic process and some may show the presence of a mineralized osteoid or chondroid matrix associated with bone destruction, periosteal reaction, and a soft-tissue mass. Other features include the floating tooth' resulting from resorption of bone around a root (Fig6a &Fig 6b).

A dental scan can be prescribed as part of the evaluation before extracting mandibular wisdom teeth when a suspected proximity of the mandibular canal is seen on the initial x-rays (dental panorama and/or retroalveolar or occlusal negatives). This could lead to a more complicated surgery. The Dentascan allows the clinician to perfectly locate the tooth on the dental arch, together with its position and in relation to adjacent teeth. It guides the surgical approach by indicating the vestibular or lingual position of

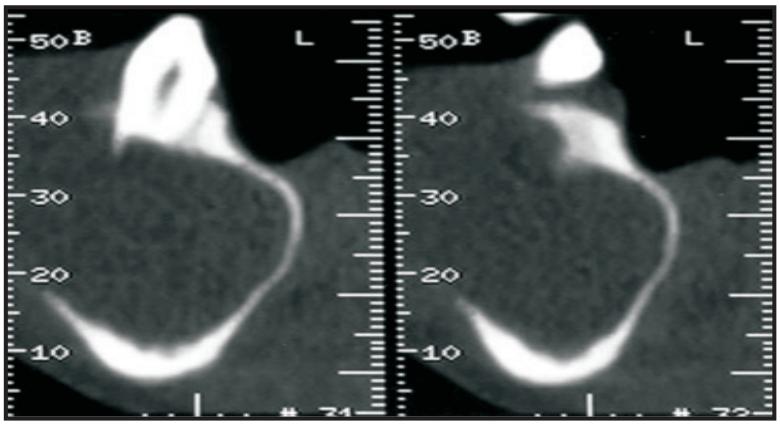

Fig 4 : Ameloblastoma ,cross sectional view shows a well defined osteolytic lesion in the anterior mandible.Root resorption in the root of canine is seen

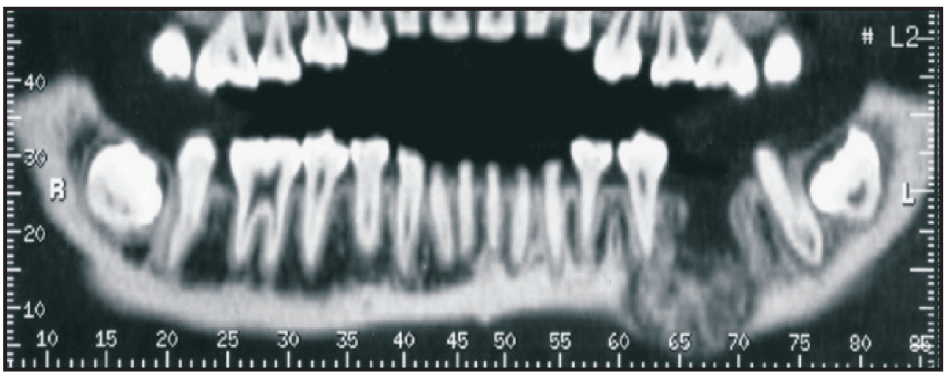

Fig 5a:Cementoblastoma dentascan panoramic l view shows a well defined expansile ground-glass lesion with a radiolucent halo in the left body of the mandible

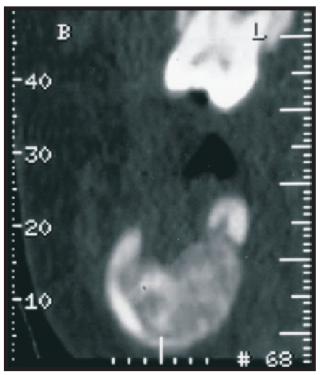

Fig 5b: The cross-sectional views depict the relation of the teeth with the ground-glass lesion. The lingual bony cortex is lost probably due to the pressure erosion.

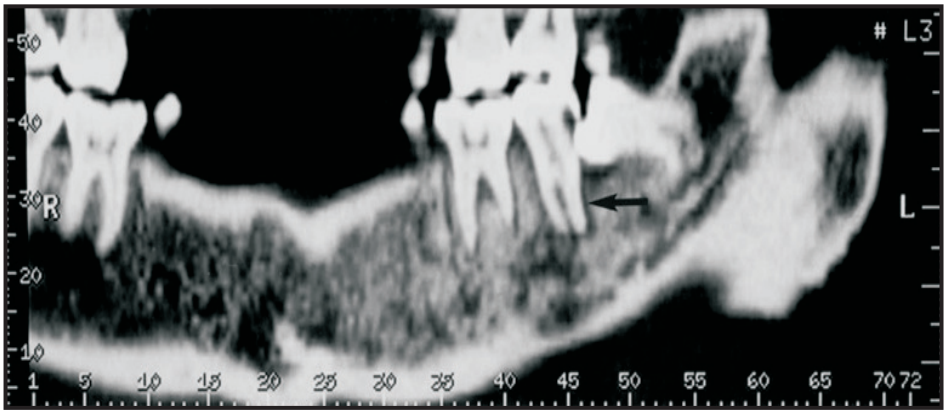

Fig 6a : Osteogenic sarcoma. DentaScan (a) panoramic views show ill-defned sclerosis of the left mandible extending to the symphysis

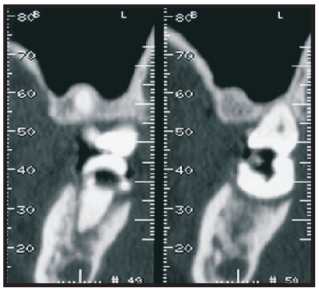

Fig 6b: The cross-sectional view also demonstrates the multifocal hypodensities in the sclerotic mandibular medulla. the periodontal space of the left premolar and molar are slightly widened with floating tooth

either the tooth or the bud. It gives the exact position of the mandibular canal with regards to the apexes[15], which can be at some distance, in contact with a lingual vestibular or apical position, or even in the mandibular canal (Fig.7).

2.3 Other uses

Utility of Dentascan is not only confined to preoperative assessment of bone but it also find its usage in endodontology as extra canals are a common findings and missing these canals leads to endodontic treatment failure. Hess pointed out that 54% of his 513 maxillary molar specimens had four canals[13]. Intra oral radiographs are a two dimensional imaging modality of a three dimensional structure. Hence, anatomy in the third dimension cannot be assessed on radiographs. Because root canals tend to lie one behind the other in buccolingual plane, they get superimposed onto each other on periapical panoramic radiographs and easily go undetected [14]. Dental CT is reformatting software used along with spiral / helical CT and allows assessment in all three dimensions. It provides axial, panoramic, paraxial and 3D volume rendering which helps in diagnosis purpose (Fig.8)

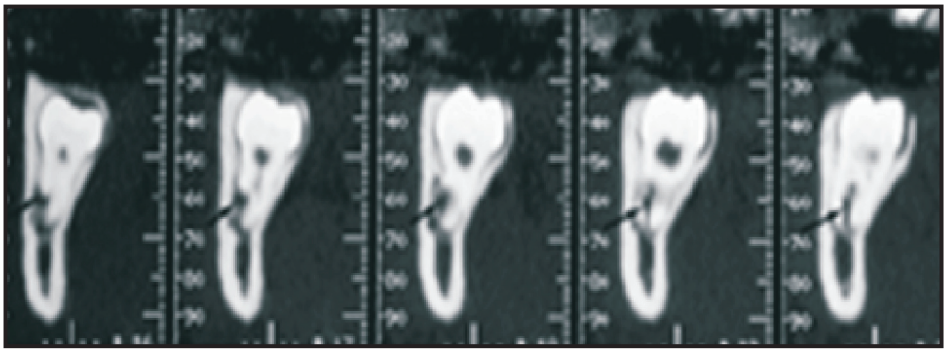

Fig 7:impacted wisdom tooth whose apex is around the mandibular canal

Fig 8: Extra canals in right maxillary molars

3. Preparation Made For A Dentascan

The examination is very simple and painless, and can easily be performed in a matter of minutes. Wear loose comfortable clothing without metal snaps or zippers, such as a cotton sweat suit. Patient might be asked to change into a hospital gown. Do not wear any makeup jewellery Remove any dentures, wigs, hairpins and hearing aids. Notify the radiologist if the patient is pregnant or breastfeeding Patients who are allergic to iodine and shellfish should be medicated prior to the examinations.

3.1 PATIENT'S POSITIONING AND EXPOSURE PARAMETER

In Dentascan the images are acquired by high resolution spiral CT equipment. The mandible is are maintained in a fixed positioning on a styrofoam surface, attached to the head holder of the CT equipment in order to stimulate the patient's correct positioning in which the mandibular base is perpendicular to the horizontal plane. High resolution,1.5 mm thick axial slices with 1 mm slice interval,120 kVp,120Ma, 512512 matrix had been used as the protocol

of CT examination. The axial CT data is transferred to a workstation and reformatted by Dentascan to generate paraxial and panoramic images and printed on films. The archived axial CT data can be stored on CD- R and transferred to a personal computer with 15.1 inch LCD monitor. Paraxial and Panoramic images can be reconstructed using Dentascan software.

4. Discussion

The CT scan in addition with Dentascan reconstructions gives a very good performance that should not be limited to a pre-implant evaluation. There are several indications in general dentistry even if it should not replace classical radiographs: panoramic, retro-alveolar and occlusal x-rays. After the initial radiological evaluation, it defines ambiguous findings on plain films and guides the therapeutic attitude. It can also be prescribed in the case of a negative radiological evaluation when the clinical examination gives strong doubts on the pathology. In all cases, a very precise topographical evaluation of the defects will guide the clinician in his diagnosis and surgical treatment. As CT is widely available, Dentascan can play a wider role in evaluating lesions of the mandible and maxilla. It provides valuable information in the assessment of oral cavity tumours (pre-and post-operative, post-radiotherapy); lesions of the jaw (benign and malignant, infection) and details of tooth anatomy in endodontics.

Any comparison of the radiation risk from CT[16] with that from conventional panoramic radiography is problematic, but it would appear from the literature that clinician has to weigh these risks against the benefit in diagnostic yield in planning treatment. It is suggested that for routine cases where implants of suitable length can be inserted safely, panoramic radiographs are sufficiently accurate. But in cases where measured vertical height is inadequate and the option of inserting the implant lateral to inferior canal is considered (for mandible), CT scanning (Dentascan) serves the surgical team as comprehensive examination to achieve optimum results. The same considerations apply to implants located beneath the maxillary sinus.

5. Conclusion

Case selection for assessment with Dentascan is very important with regard to radiation exposure. Further studies needs to be done to find the feasibility of Dentascan in other fields of dentistry such as endoperiolesions and detection of iatrogenic oro antral communication.

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